7-31-00

PTO/SB/05 (2/98)

Please type a plus sign (+) inside this box → [+]

Approved for use through 09/30/00. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	01827.0018.00US00
First Named Inventor or Application Identifier	Huan-Yu Su
Title	FLEXIBLE VARIABLE RATE VOCODER FOR WIRELESS COMMUNICATION SYSTEMS
Express Mail Label No.	EL 557885210US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] *Fee Transmittal Form (Form PTO-1082)
(Submit an original and a duplicate for fee processing)
2. [X] Specification [*Total Pages* 11]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R&D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claims
- Abstract of the Disclosure

3. [X] Drawing(s) *(35 USC 113)* [*Total Sheets* 4]
4. Oath or Declaration [*Total Pages*]
a. [ ] Newly executed (original or copy)
b. [ ] Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
[Note Box 5 below]
i. [ ] DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. [ ] Microfiche Computer Program *(Appendix)*
6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. [ ] Computer Readable Copy
b. [ ] Paper Copy (identical to computer copy)
c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [ ] Assignment Papers (cover sheet & document(s))
8. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [ ] English Translation Document *(if applicable)*
10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [ ] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503)
13. [ ] *Small Entity Statement(s) [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*

*NOTE FOR ITEMS 1 & 14 IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28)

15. **If a CONTINUING APPLICATION,** *check appropriate box and supply the requisite information:*
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: /
Prior Application Information: Examiner: Group/Art Unit:

16. CORRESPONDENCE ADDRESS

[X] *Customer Number or Bar Code Label* 22930 *or* [X] *Correspondence address below*
(Insert Customer No. or Attach bar code label here)

NAME	Robert C. Laurenson HOWREY SIMON ARNOLD & WHITE, LLP				
ADDRESS	Box No. 34 1299 Pennsylvania Avenue, N.W.				
CITY	Washington	*STATE*	DC	*ZIP CODE*	20004-2402
COUNTRY	US	*TELEPHONE*	202-783-0800	*FAX*	202-383-7195

Name (Print/Type)	Robert C. Laurenson	*Registration No (Attorney/Agent)*	34,206
Signature		*Date*	July 27, 2000

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Box Patent Application, Washington, DC 20231.

Howrey Docket No. 01827.0018.00US00
Conexant Ref. No.: 99RSS293

FORM PTO-1082
Express Mail No. EL557885210US

HOWREY SIMON ARNOLD & WHITE, LLP
Box No. 34
1299 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2402
(858) 622-5100

Box Patent Application
COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of **Huan-Yu Su** for **Flexible Variable Rate Vocoder for Wireless Communication Systems**.

☐ Also, enclosed are:

1. Utility Patent Application Transmittal
2. Utility Application
3. Drawings
4. Reply Postcard

	(Col. 1)	(Col. 2)	SMALL ENTITY			OTHER THAN A SMALL ENTITY	
FOR	NO. FILED	NO. EXTRA	RATE	FEE	OR	RATE	FEE
BASIC FEE				$ 345.00	OR		$ 690.00
TOTAL CLAIMS	27-20 =	7	x 9 =	0.00	OR	x 18 =	126.00
INDEP. CLAIMS	3-3 =	0	x 39 =	0.00	OR	x 78=	0.00
☐ MULTIPLE DEPENDENT CLAIM PRESENTED			+ 130 =	0.00	OR	+ 260 =	0.00
*If the difference in Col. 1 is less than zero, enter "0" in Col. 2			TOTAL	$	OR	TOTAL	$ 816.00

This application is being filed under 37 C.F.R. §1.53(b)(1) without declaration and filing fee.

HOWREY SIMON ARNOLD & WHITE, LLP

Date: July 27, 2000

Robert C. Laurenson, Reg. No. 34,206

S P E C I F I C A T I O N

FLEXIBLE VARIABLE RATE VOCODER FOR WIRELESS COMMUNICATION SYSTEMS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to speech vocoders, and, more specifically, to flexible variable rate vocoders for wireless communication systems.

2. Background

In digital wireless communications systems, a speech vocoder is the device which compresses the digitized the speech signals prior to communication thereof over the wireless channel. Many different compression schemes for speech signals are currently used, including PCM (pulse code mudulation), ADPCM (adaptive differential pulse code modulation), and EVRC (Enhanced Variable Rate-Coder). At present, the rate at which a vocoder functions is subject to constraints imposed by the network designer.

For example, in current commercial CDMA (code division multiple access) systems, the rate at which the vocoder functions is limited to four possible rates: full rate, half rate, quarter rate, or eight rate. At full rate, speech is encoded at 170 bits per frame, at half rate, 80 bits per frame, at quarter rate, 40 bits per frame, and at eighth rate, 16 bits per frame. With a 20 ms frame duration, these figures translate into a rate of 8.5 kbit/sec. for full rate, 4 kbit/sec. for half rate, 2 kbit/sec. for quarter rate, and 0.8 kbit/sec. for eighth rate. The rate which is chosen at a time depends on the level of speech activity. For a high level of activity, the full rate is chosen, while for no activity (e.g. silence background), the eighth rate is chosen. For intermediate levels of activity, the half or quarter rates are chosen. Rates greater than 8.5 kbits/sec. or less than 0.8 kbits/sec. are not possible. Since the bit-rate for a particular speech signal varies depending upon the nature of that speech signal, only the average bit-rate is of interest. The average bit-rate is also called average data-rate (ADR).

Recently, a proposal has been made for a selectable mode vocoder (SMV) which is capable of operating in one of three modes. *See* Test Plan and Requirements

of the Selectable Mode Vocoder, version 8.0, 3GPP2-C13-19991912-007R1, which is hereby fully incorporated by reference herein as though set forth in full. In mode 0, the target ADR of the vocoder is the same as the EVRC (Enhanced Variable Rate Vocoder) rate defined in IS-127 standard. In mode 1, the target ADR is roughly 0.7 that of the EVRC. In mode 2, the target ADR is 0.55-0.6 that of the EVRC, depending on the input signal characteristics, such as speech without background noise or speech with background noises. It is contemplated that the mode of operation of a SMV will be determined by the operator based upon the tradeoff between the network capacity which is available in the system and the desired quality of service.

A problem with this approach is that, if the network cannot accommodate a demand for services at the desired level of quality, the user will be denied access to the system. Consider, for example, a user who is seeking access to the system in the case in which the network is near saturation. If the desired level of speech activity requires mode 0, and mode 0 cannot be accommodated by the system, the user will be denied access to the system.

A related problem is loss of flexibility due to the limited number of discrete modes of operation which are available. As detailed above, this loss of flexibility results in users who are denied access to the system. It will also result in lost profit opportunities as there may be users willing to pay for a higher quality of service than available in the limited number of discrete modes of operation.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention as broadly described herein, there is provided a flexible variable rate vocoder comprising a rate determination module which selects a target average data rate from a continuous or pseudo-continuous range of possible target rates responsive to at least network parameter and at least one external parameter, and a rate implementation module which sets the rate of outgoing frames so that the actual rate averaged over a predetermined time period is approximately equal to the target average data rate.

In one embodiment, the rate implementation module sets the rate of outgoing frames by adjusting the relative percentages of outgoing frames which are full rate,

half rate, quarter rate, and eighth rate frames such that the average actual rate is approximately equal to the target average rate.

In one implementation, the network parameter is available network capacity, and the external parameter is an indicator of the class of service desired or purchased by a user. In one implementation example, the available classes of service comprise premium, standard, and economy. When a demand for network services is received, a determination is made if the network can accommodate the demand at the desired quality. If the network cannot accommodate the demand at the desired quality, the network will reduce the ADR of all non-premium users until the network can accommodate the demand at the desired quality. If the network can easily accommodate the demand at the desired quality, the network will do so and may then even increase the ADR of all users until the network is close to saturation. In this implementation, the ADR of a premium user starts out at a relatively high rate and remains so despite subsequent changes in demand for network resources. The ADR of a standard user starts out at a relatively moderate rate, and then changes over time with subsequent changes in demand for network resources. The ADR of an economy user starts out relatively low, and then changes over time with subsequent changes in demand for network resources.

In another implementation, the network parameter is available capacity, and the external parameter is an indicator of the subject matter of the information sought to be transmitted. In one implementation example, the available classes of subject matter which can be transmitted comprise voice, data, music, or video. When a demand for network services is received, a determination is made whether the network can accommodate the additional demand at the desired quality. If the network cannot do so, it will reduce the ADR for selected categories of subject matter, i.e., music, until the network can accommodate the demand at the desired quality. If the network can easily accommodate the desired demand, it will do so, and may even increase the ADR for selected categories of subject matter, e.g., voice and data.

In other implementation examples, the external parameter may be the time of day, the weather, etc. Related methods of operation are also provided.

DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the discrete quality of service/ capacity tradeoff options which are available in a conventional network.

Figure 2 illustrates the continuous or pseudo-continuous quality of service/capacity tradeoff options which are available in a network configured in accordance with the subject invention.

Figure 3 illustrates an embodiment of a flexible variable rate vocoder in accordance with the subject invention.

Figure 4 illustrates an embodiment of a method of operation in accordance with the subject invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of a flexible variable rate vocoder in accordance with the subject invention is illustrated in Figure 3. As illustrated, in this embodiment, the vocoder includes a rate determination module 8 which selects a target average data rate from a continuous or pseudo-continuous range of possible target rates responsive to at least network parameter 7a and at least one external parameter 7b, and a rate implementation module 18 which sets the rate of outgoing frames so that the actual rate averaged over a predetermined time period is approximately equal to the target average data rate.

For purposes of this disclosure, the term "pseudo-continuous" for a range of modes or parameters means a set of discrete range of modes or parameters that are fine enough to approximate a continuous range of the modes or parameters.

In one implementation, the rate implementation module 18 sets the rate of outgoing frames by adjusting the relative percentages of outgoing frames which are full rate, half rate, quarter rate, and eighth rate frames such that the average actual rate is approximately equal to the target average rate. In this implementation, the rate implementation module 18 comprises switch 9, full rate module 10a, half rate module 10b, quarter rate module 10c, eighth rate module 10d, and multiplexor 11. The multiplexor 11 receives the frames from each of the modules 10a, 10b, 10c, 10d, and serially outputs them on signal line 12.

In other implementations, the rate implementation module 18 is not limited to setting the relative percentages of frames which are full rate, half rate, quarter rate, and eighth rate. For instance, the ITU has standardized a G.729 Annex I where five coding rates are used: 11.2kbit/sec., 8kbit/sec., 6.4kbit/sec., 1.5kbit/sec., and 0kbit/sec. Implementations are possible in which the rate implementations module 18 sets the relative percentages of frames which are within these five coding rates. In addition, implementations are possible in which the rate implementation module 18 sets the relative percentages of frames which are within the eight coding rates which are available in the GSM Adaptive Multi-Rate (AMR) coding system.

In one implementation, the network parameter is available network capacity, and the external parameter is an indicator of the class of service desired or purchased by a user. In one implementation example, the available classes of service comprise premium, standard, and economy. When a demand for network services is received, a determination is made if the network can accommodate the demand at the desired quality. If the network cannot accommodate the demand at the desired quality, the network will reduce the ADR of all non-premium users until the network can accommodate the demand at the desired quality. If the network can easily accommodate the demand at the desired quality, the network will do so and may then even increase the ADR of all users until the network is close to saturation.

In this implementation, the ADR of a premium user starts out at a relatively high rate, and remains so despite subsequent changes in demand for network resources. The ADR of a standard user starts out at a relatively moderate rate, and then changes over time with subsequent changes in demand for network resources. The ADR of an economy user starts out relatively low, and then changes over time with subsequent changes in demand for network resources.

The quality of service/capacity tradeoffs which are available in this implementation can be represented by the curve 6 in Figure 2. The initial quality of service/capacity tradeoff represented by the premium class of service might be represented by numeral 6a; that for the standard class of service, by numeral 6b; and that for the economy class of service, by numeral 6c. As changes in the demand for network services occur, a premium user can move upwards along the curve, but never downwards. The standard user can move upwards or downwards. The economy user

can move upwards or downwards. These movements are represented by the arrows in Figure 2. Because of these movements, the entirety of the curve 6 in Figure 2 can be traversed. The result is that a continuous or pseudo-continuous range of quality of service/capacity tradeoffs will be made available to the user.

Compared to the prior art SMV vocoder, an advantage of the vocoder of Figure 3 is reduction in the number of users denied access to the system. Consider a system which is near saturation at the time a user requests access to the system. If the system cannot accommodate the desired level of quality of service, and existing users have already been downgraded to mode 2, the user will be denied access to the system. In a system of the subject invention, however, the ADRs of non-premium users will be downgraded until the system can accommodate the new user. Of course, if the user is a non-premium user as well, the ADR assigned to this user will be downgraded as well from its initial nominal value along with all the other non-premium users.

Compared to the prior art system, another advantage is the ability to accommodate users which desire a higher quality of service that available through mode 0. In the conventional system, such a mode of service is unavailable. In the system of the subject invention, however, such a class of service could be made available.

In another implementation, the network parameter is available capacity, and the external parameter is an indicator of the subject matter of the information sought to be transmitted. In one implementation example, the available classes of subject matter which can be transmitted comprise voice, data, music, or video. When a demand for network services is received, a determination is made whether the network can accommodate the additional demand at the desired quality. If the network cannot do so, it will reduce the ADR for selected categories of subject matter, i.e., music, until the network can accommodate the demand at the desired quality. If the network can easily accommodate the desired demand, it will do so, and may even increase the ADR for selected categories of subject matter, e.g., voice and data.

In other implementation examples, the external parameter may be the time of day, the weather, etc.

An embodiment of a method of operation in accordance with the subject invention is illustrated in Figure 4. The process begins when a demand for network services is initiated. In one implementation, the demand includes a desired level of quality, e.g., premium, standard, or economy. In another implementation, the demand includes a category of subject matter sought to be transmitted, e.g., voice, data, music, image, video, audio, etc., each of which is associated, through one or more lookup tables, with a desired level of quality. The process proceeds to task 14, in which it is queried whether the network can accommodate the demand at the desired level of quality. If not, the process proceeds to step 15, which comprises selectively decreasing the ADRs of existing users (and typically the new user as well) until the demand can be accommodated at the desired quality of service. In one implementation, this step occurs by decreasing the ADRs of non-premium users. In another implementation, this step occurs by decreasing the ADRs of selected categories of subject matter, e.g., music and data. Turning back to task 14, is the demand can be accommodated at the desired level of quality, task 16 is performed. Task 16 comprises accommodating the demand at the desired level of quality. Optional step 17 is then performed which comprises selectively increasing the ADRs of existing users (and typically the new user as well) until the network loading is within a predetermined amount, e.g., 10%, from saturation. In one implementation, this step occurs by increasing the ADRs of all users. In another implementation, it occurs by increasing the ADRs of selected classes of users, e.g., premium and standard users. In yet another implementation, it occurs by increasing the ADRs of selected categories of subject matter, e.g., voice and data.

The vocoder of the subject invention may be included within a transceiver, transmitter, or receiver which in turn may be included in a wireless device, including a mobile wireless device such as a handset, or an immobile wireless device, such as a television set-top box.

While embodiments, implementations, and implementation examples have been shown and described, it should be appreciated that there are many more embodiments, implementations, and implementation examples that are within the scope of the subject invention. Accordingly, the subject invention is not to be restricted, except in light of the appended claims and their equivalents.

CLAIMS

What is claimed is:

1. A flexible variable rate vocoder comprising a rate determination module which selects a target average data rate from a continuous or pseudo-continuous range of possible target rates responsive to at least network parameter and at least one external parameter, and a rate implementation module which sets the rate of outgoing frames so that the actual rate averaged over a predetermined time period is approximately equal to the target average data rate.

2. The vocoder of claim 1 wherein the rate implementation module is configured to adjust the relative percentages of outgoing frames which are full rate, half rate, quarter rate, and eighth rate frames such that the average actual rate is approximately equal to the target average rate.

3. The vocoder of claim 1 wherein the network parameter is available network capacity, and the external parameter is an indicator of the class of service desired or purchased by a user.

4. The vocoder of claim 1 wherein the available classes of service comprise premium, standard, and economy.

5. The vocoder of claim 4 in a wireless communication network wherein, when a demand for network services is received, if the network cannot accommodate the demand at the desired quality, the network will reduce the ADR of all non-premium users until the network can accommodate the demand at the desired quality.

6. The vocoder of claim 4 in a wireless communication network wherein, when a demand for network services is received, if the network can easily accommodate the demand at the desired quality, the network will do so and then even increase the ADR of all users until the network is close to saturation.

7. The vocoder of claim 2 wherein the rate implementation module comprises a switch, a full rate module, a half rate module, a quarter rate module, an eighth rate module, and a multiplexor, wherein the switch switches amongst the modules, and the multiplexor receives the frames from each of the modules, and serially outputs them on a signal line.

8. The vocoder of claim 1 wherein the network parameter is available capacity, and the external parameter is an indicator of the subject matter of the information sought to be transmitted.

9. The vocoder of claim 8 wherein the available classes of subject matter which can be transmitted comprise voice, data, music, image or video.

10. The vocoder of claim 9 in a wireless communication network wherein, when a demand for network services is received, if the network cannot accommodate the additional demand at the desired quality, it will reduce the ADR for selected categories of subject matter, until the network can accommodate the demand at the desired quality.

11. The vocoder of claim 9 in a wireless communication network wherein, when a demand for network services is received, if the network can easily accommodate the desired demand, it will do so, and then increase the ADR for selected categories of subject matter until the network is within a target amount of saturation.

12. The vocoder of claim 1 wherein the external parameter is the time of day.

13. The vocoder of claim 1 wherein the external parameter is the weather.

14. The vocoder of claim 1 in a transceiver, transmitter, or receiver.

15. The transceiver, transmitter, or receiver of claim 1 in a wireless device.

16. The wireless device of claim 15 which is a mobile wireless device.

17. The wireless device of claim 15 which is an immobile wireless device.

18. The mobile wireless device of claim 16 which is a handset.

19. A method of responding to a demand for network services comprising the following steps:

when a demand for network services is initiated, the demand including a desired level of quality or category of subject matter sought to be communicated, querying whether the network can accommodate the demand at the desired level of quality;

if not, selectively decreasing the ADRs of users until the demand can be accommodated at the desired quality of service; and

if so, accommodating the demand at the desired level of quality.

20. The method of claim 19 further comprising, if the network can accommodate the demand at the desired level of quality, selectively increasing the ADRs of users until the network is within a predetermined amount of saturation.

21. The method of claim 19 wherein the desired classes of service comprise premium, standard, and economy classes of service, and the selectively decreasing step comprises decreasing the ADRs of selected classes of users until the demand can be accommodated at the desired level of quality.

22. The method of claim 19 wherein the classes of subject matter comprise voice, data, music, image, and video, and the selectively decreasing step comprises selectively decreasing the ADRs of selected classes of subject matter until the demand can be accommodated at the desired level of quality.

23. The method of claim 21 wherein the selected classes of users comprise non-premium users.

24. The method of claim 20 wherein the selectively increasing step comprises increasing the ADRs of all users.

25. The method of claim 20 wherein the selectively increasing step comprises increasing the ADRs of selected classes of users.

26. The method of claim 20 wherein the selectively increasing step comprises increasing the ADRs of selected categories of subject matter.

27. A flexible variable rate vocoder comprising a rate determination module which selects a target average data rate from a continuous or pseudo-continuous range of possible target rates responsive to at least network parameter or at least one external parameter, and a rate implementation module which sets the rate of outgoing frames so that the actual rate averaged over a predetermined time period is approximately equal to the target average data rate.

ABSTRACT

A flexible variable rate vocoder and related method of operation. The vocoder selects a target average data rate responsive to at least one network parameter and at least one external parameter.

09827618 - 092799

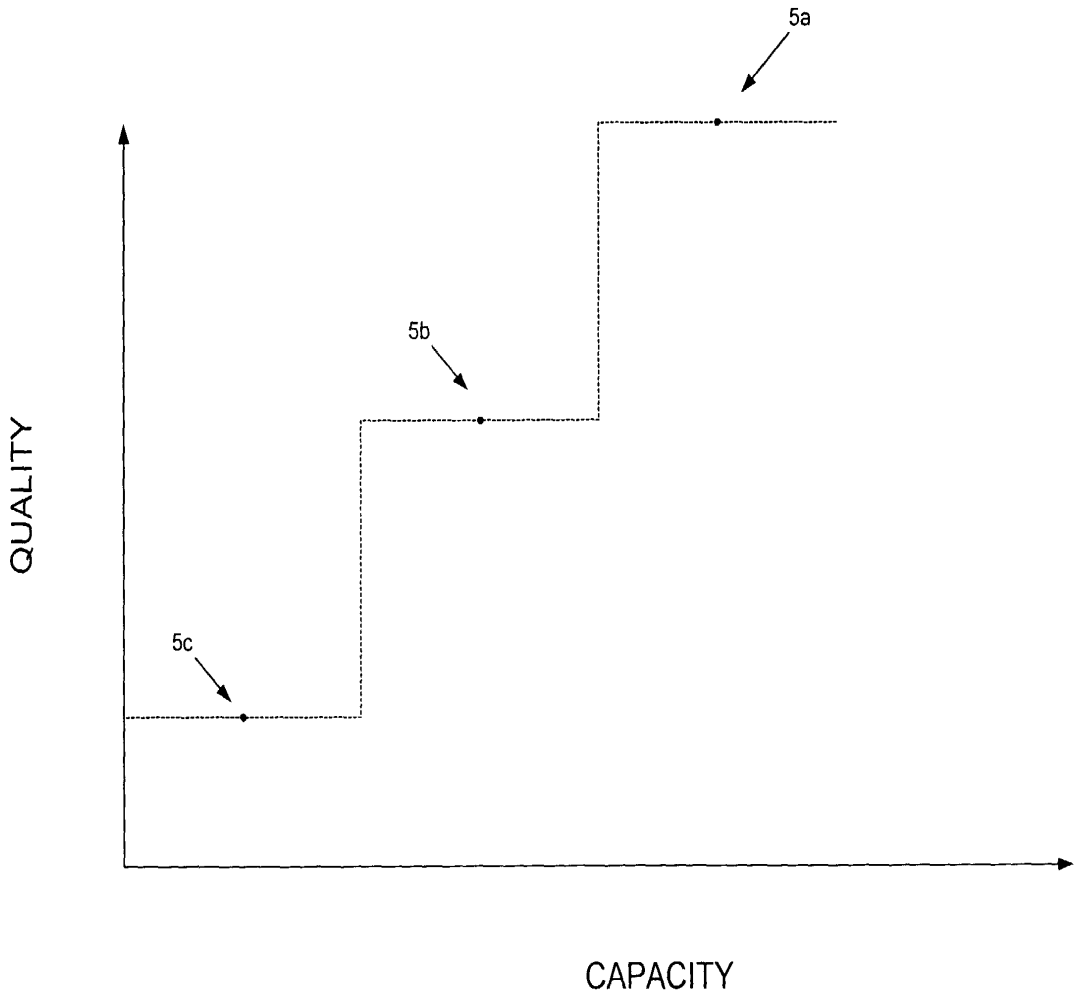

FIGURE 1

SCANNED

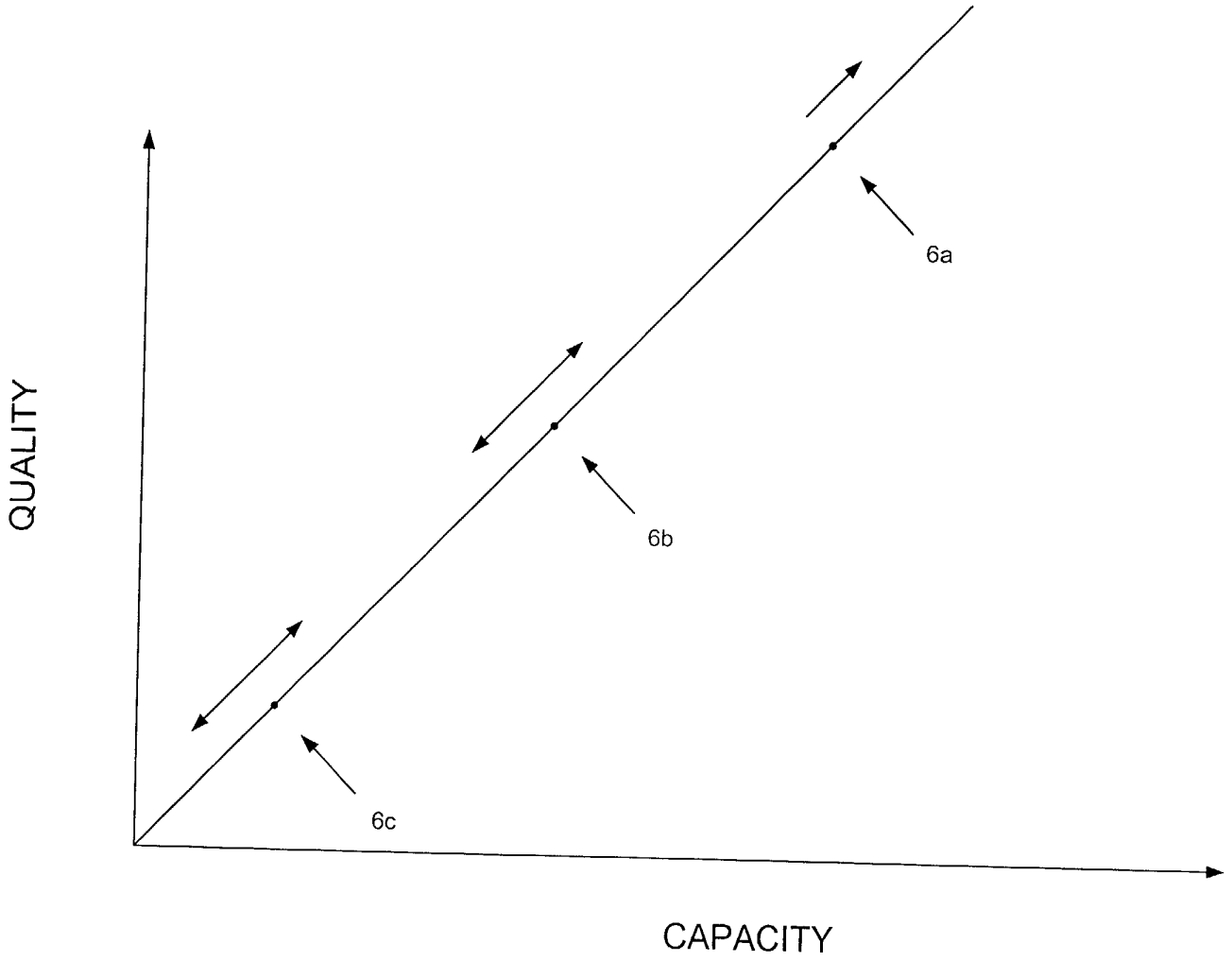

FIGURE 2

GB 2 372 975 A

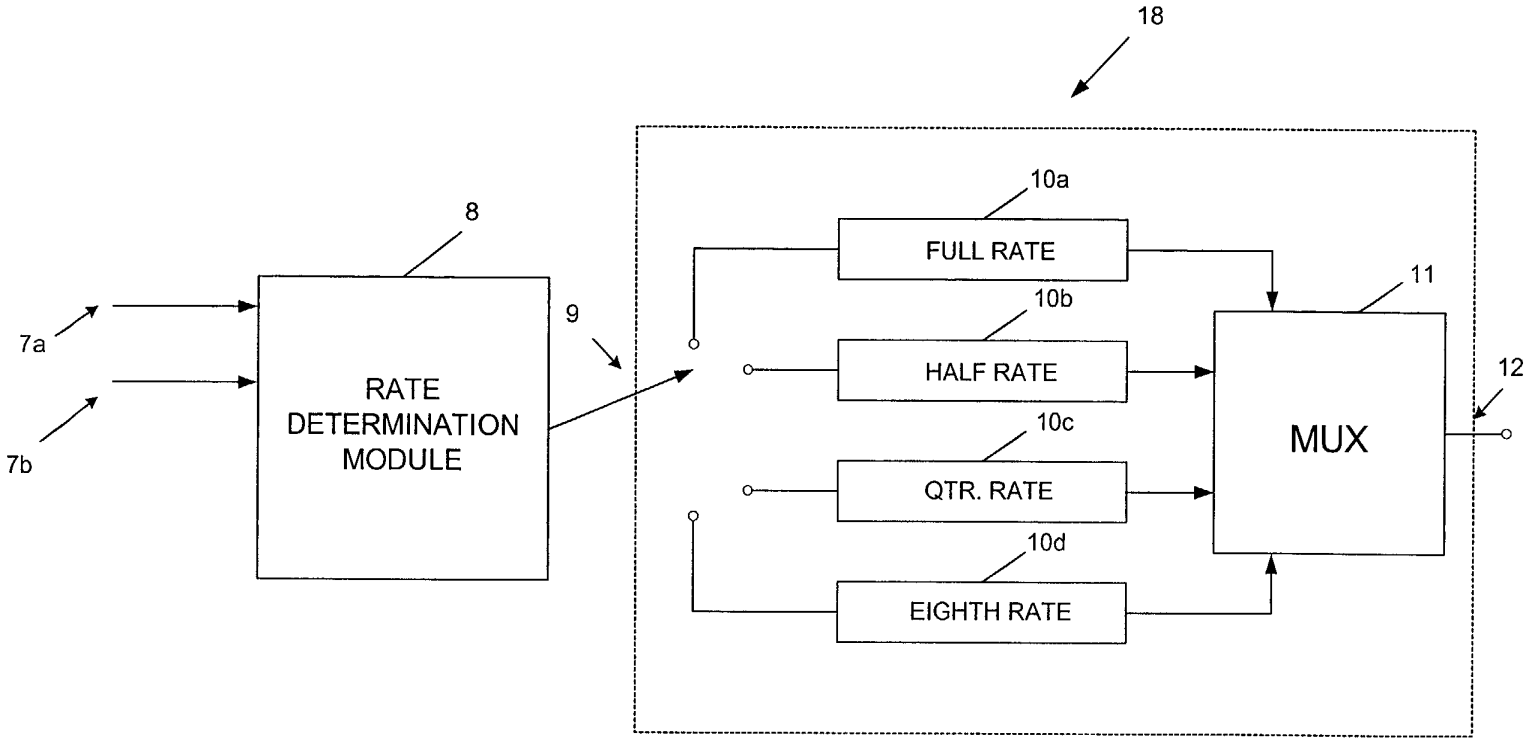

FIGURE 3

US6373975 - 02/16/2002

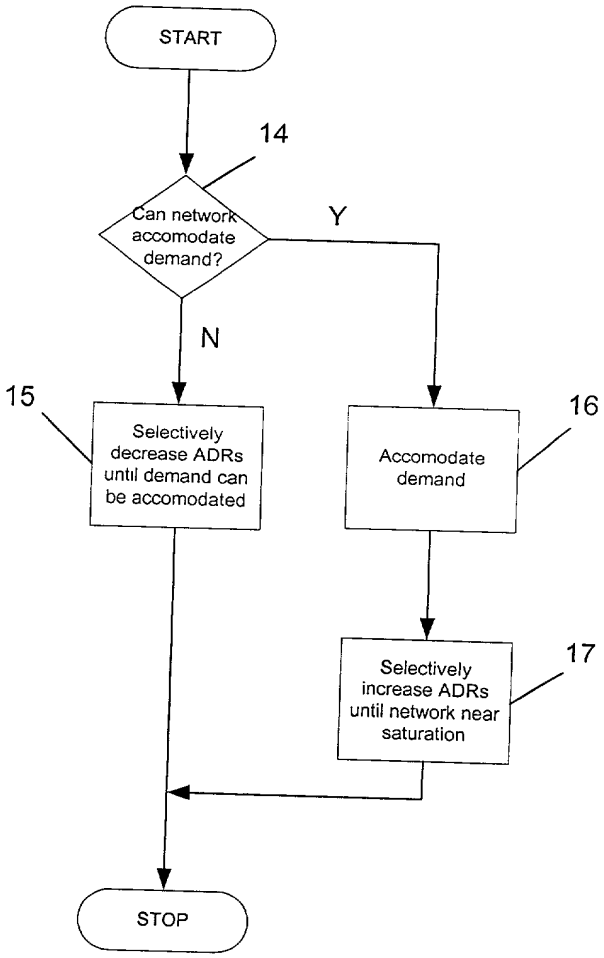
START
14
Can network accomodate demand?
Y
N
15
Selectively decrease ADRs until demand can be accomodated
16
Accomodate demand
17
Selectively increase ADRs until network near saturation
STOP

FIGURE 4